

Analysis of the Influence of Knee Joint Balancing Manipulation on the Rehabilitation of Patients after Total Knee Arthroplasty

Tian Zhang*, Hua Li, Xiaohua Dong, Dakuan Zhang

BeiJing JiShuiTan Hospital GuiZhou Hospital, Guiyang 550021, Guizhou Province, China

*Corresponding author: Tian Zhang, gzkfk2011@foxmail.com

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Abstract: This paper aims to explore the clinical effect of knee-balancing manipulation after total knee arthroplasty. A total of 84 patients with total knee arthroplasty in our hospital were selected. The time of admission and treatment was from March 2021 to March 2023. They were divided into the study group ($n = 42$) and the control group ($n = 42$) by lottery method with a digital table. The patients in the control group received conventional rehabilitation, and the patients in the study group received balancing manipulation of the knee joint. The Hospital for Special Surgery (HSS) knee function score and gait indicators were compared between the two groups. The HSS score of patients in the study group was higher than that in the control group at 2 weeks after operation ($P < 0.05$). The gait indexes of patients in the study group were higher than those in the control group at 2 weeks after operation ($P < 0.05$). Knee-balancing manipulation after total knee arthroplasty can improve knee joint function and restore gait, which has the value of popularization and application.

Keywords: Knee-balancing manipulation; Total knee arthroplasty; Rehabilitation

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1. Introduction

Total knee arthroplasty is the main surgical method for the clinical treatment of advanced knee osteoarthritis and knee joint deformity. During the operation, artificial joints are used to replace the diseased knee joint, which can relieve pain and improve knee joint function^[1]. Total knee arthroplasty has a large trauma area, which can destroy the integrity and continuity of the tissues around the knee joint, and affect the patient's balance ability and gait. Therefore, an effective rehabilitation treatment plan should be adopted after the operation^[2,3]. Knee-balancing manipulation is based on traditional Chinese massage therapy, combined with knee osteoarthritis lesion characteristics and knee anatomical structure characteristics to determine the treatment plan, with satisfactory curative effect^[4]. In this study, 84 samples of total knee arthroplasty patients were selected to explore the effect of knee-balancing manipulation on postoperative rehabilitation of patients.

2. Materials and methods

2.1. Demographic of study population

The research process and sample selection plan were submitted to the approval of the Medical Ethics Committee. 84 total knee arthroplasty patients admitted to our hospital were selected. The admission time was from March 2021 to March 2023. They were divided into study group ($n = 42$) and control group ($n = 42$) by lottery method with digital table. In the study group, there were 24 males and 18 females. The age range was 58–66 years old, with an average of 62.58 ± 3.69 years old, and the disease duration ranged from 7 months to 5 years, with an average of 2.68 ± 0.85 years. In the control group, there were 22 males and 20 females. The age range was 60–65 years old, with an average of 62.64 ± 3.72 years old. The disease course ranged from 6 months to 5 years, with an average of 2.75 ± 0.89 years. The general information of the two groups of patients was comparable ($P > 0.05$).

Inclusion criteria were patients who meet the diagnostic criteria for knee osteoarthritis in the “Guidelines for the Diagnosis and Treatment of Osteoarthritis,” patients who meet the indications for total knee arthroplasty, and patients who understand the research process and content, and sign the consent form.

Exclusion criteria included patients with lower limb dysfunction caused by central nervous system diseases, patients with muscle atrophy, and patients with mental illness or other medical diseases.

2.2. Methods

Patients in the control group received conventional rehabilitation treatment after operation. The affected limb was raised 1 day after operation to maintain the functional position of the knee joint. Passive knee joint flexion and extension training was performed 3 to 7 days after operation, each training was 30 minutes, and the range of flexion and extension was gradually increased during the training period. Ankle pump exercises were performed 100–300 times a day, and patients were assisted in isometric quadriceps contraction training on the hospital bed, performed 300–500 times a day. Patients were guided to perform straight leg raising training 8 days after surgery, and maintain a sitting position, move their knee joints in a painless state, and parallel resistance flexion and extension training, walking training, and up and down stairs training.

According to the treatment plan of the control group, the patients in the study group were treated with knee joint balancing manipulation, plucking, and straightening out, and pressing and kneading for 1–3 days after operation, twice a day. Three days after the operation, patella release, knee flexion, and tendon regulation were performed, twice a week. The treatments are described in detail as follows.

- (1) Pressing and kneading method. The doctor instructed the patient to maintain an upright sitting position beside the bed, with the legs drooping naturally, properly protected the surgical incision, and massaged the soft tissue around the knee joint on the outside of the incision for 3–5 minutes. The inner and outer sides of the knee joint and the tenderness points around the patella were palpated, spot kneading and massage was performed, and the intensity was gradually increased during the operation.
- (2) Poking and regulating channels manipulation. The doctor massaged the starting and ending points of the rectus femoris, sartorius, and tensor fascia lata muscles of the patient, and plucked the lateral medial and lateral sides 5–10 times, and stretched the tendons 3–6 times through the starting point toward the insertion point.
- (3) Releasing the patella. The doctor used the thumb and index finger to massage the inner and outer areas of the patella for 5–10 times. After the operation is completed, the patella was pressed down with the palm toward the surface of the femoral cartilage and rubbed 6–8 times.
- (4) Regulating tendons while stretching out the legs. The starting point of the tensor fascia lata at the anterior inferior spinous spine of the patient was massaged several times, the muscle tissue was

pushed after the operation, and the lateral collateral ligament of the knee joint was massaged. The base of the palm was pushed along the direction of the iliotibial band 6–8 times. After completing the operation, the knee joint was repeatedly flexed and extended 8–10 times.

- (5) Strengthening the tendons while bending the legs. The doctor massaged the starting point of the rectus femoris muscle of the patient, pushed along the direction of the quadriceps femoris, and used the heel of the palm to push the vastus medialis and sartorius muscles 8–10 times. The calf of the patient was protected with both hands, the posterolateral muscles of the calf was pressed and kneaded 8–10 times from top to bottom, and the push method was used to smooth the calf muscle tissue 8–10 times.

2.3. Evaluation criteria

The Hospital for Special Surgery (HSS) knee function score was compared between the two groups immediately after operation and 2 weeks after operation. The scoring items included pain, muscle strength, stability, and range of motion. The score was directly proportional to the degree of good knee function. Gait analyzers were used to measure the gait indexes of the two groups immediately after operation and 2 weeks after operation, including step length, pace speed, and stride frequency.

2.4. Statistical methods

SPSS23.0 software was used to calculate various data, the measurement data was ($\bar{x}\pm s$), the test method was t , the count data was %, and the test method was χ^2 . If $P < 0.05$, there was a difference between groups.

3. Results

3.1. Comparing the HSS scores

As shown in **Table 1**, the HSS scores of patients in the study group were higher than those in the control group 2 weeks after operation ($P < 0.05$).

Table 1. Comparison of HSS scores between the two groups ($\bar{x}\pm s$)

Group	Pain		Muscle strength		Stability		Activity	
	Immediately after surgery	2 weeks after surgery	Immediately after surgery	2 weeks after surgery	Immediately after surgery	2 weeks after surgery	Immediately after surgery	2 weeks after surgery
Study group ($n = 42$)	12.38±2.05	23.55±3.68	7.14±0.85	12.33±1.86	7.14±0.68	9.94±1.25	9.17±1.05	16.58±1.96
Control group ($n = 42$)	12.41±2.09	20.06±1.77	7.09±0.92	10.75±1.02	7.19±0.64	8.27±0.66	9.22±1.09	14.95±0.88
t value	0.066	5.539	0.259	4.827	0.347	7.657	0.214	4.917
P value	0.947	0.000	0.797	0.000	0.729	0.000	0.831	0.000

3.2. Comparing the gait indicators

As shown in **Table 2**, the gait indexes of patients in the study group were higher than those in the control group at 2 weeks after operation ($P < 0.05$).

Table 2. Comparison of gait indicators between the two groups ($\bar{x}\pm s$)

Group	Step size (m)		Pace (m/s)		Cadence (step/min)	
	Immediately after surgery	2 weeks after surgery	Immediately after surgery	2 weeks after surgery	Immediately after surgery	2 weeks after surgery
Study group ($n = 42$)	0.55±0.12	0.73±0.18	0.72±0.11	0.92±0.15	90.11±6.25	102.45±6.48
Control group ($n = 42$)	0.59±0.08	0.62±0.11	0.69±0.12	0.73±0.08	90.07±6.19	97.11±3.18
t value	1.797	3.379	1.194	7.243	0.029	4.794
P value	0.076	0.001	0.236	0.000	0.977	0.000

4. Discussion

Knee osteoarthritis is a frequent knee joint disease in middle-aged and elderly people. The cause of the disease is knee joint strain, loose ligament tissue around the knee, soft tissue degeneration, knee cartilage degeneration, and secondary bone hyperplasia, which can lead to joint pain. The symptoms are pain, swelling, and limited movement. Total knee arthroplasty is an effective treatment for advanced knee osteoarthritis. During the operation, an artificial knee joint is used to replace the diseased knee joint, which can relieve pain and improve knee joint mobility^[5]. The trauma area of total knee arthroplasty is large with long recovery time. In order to improve the prognosis, an effective and reasonable rehabilitation treatment plan should be formulated and implemented after surgery^[6].

In the conventional postoperative rehabilitation treatment mode, doctors use passive exercise combined with active exercise to relax muscles and improve knee joint function, but the onset speed is slow, and some patients have poor improvement of knee joint function^[7]. According to the theory of Chinese medicine, the key to rehabilitation after total knee arthroplasty is to loosen adhesion tissue, relieve spasm, adjust the stress distribution of the knee joint, and restore the normal anatomical structure of muscles and bones^[8]. Knee joint balancing techniques and Chinese massage techniques are based on restoring the balance of soft tissue around the knee joints, which can achieve the effect of tendon binding, bone strengthening, and muscle softening. In the knee joint balancing manipulation therapy mode, the doctor touches the muscles around the knee to detect and repair abnormal knots in time. By massaging the pain points around the knee, the meridian *qi* in the body can be stimulated, the circulation of *qi* and blood can be improved, and the patient's sensitivity to pain and postoperative pain can be reduced^[9,10]. During the treatment of knee joint balancing manipulation, the physician focuses on poking the rectus femoris, sartorius, and tensor fascia lata, and straightening out the muscle tissue, which can restore the soft tissue around the knee joint to a state of "dynamic and static balance," combined with the use of patellar release manipulation, it can promote the balance of medial and lateral tension, thereby improving the motor function of the patella^[11]. The tendon-regulating manipulation of the knee joint can loosen the adhesion tissue, make the force on the soft tissue conform to the direction of knee joint movement, and increase the range of motion of the knee joint. Compared with the conventional rehabilitation treatment plan, knee-balancing manipulation after total knee arthroplasty can comprehensively adjust the physiological functions of joints, muscles, and soft tissues, and accelerate the recovery of knee joint function. The treatment is simple, with few adverse reactions and patient tolerance. The degree of cooperation is good, and it has high clinical application value^[12].

The results of this study confirmed that the postoperative HSS score and gait-related indicators of the study group were significantly better than those of the control group, suggesting that knee-balancing manipulation therapy after total knee arthroplasty can improve gait and promote the recovery of knee joint function. Conventional knee joint functional training mostly adopts a combination of active and passive movements, the training efficiency is relatively slow, thus the rehabilitation effect on muscles and soft tissues is poor. According to Chinese medicine, total knee replacement can damage the muscles, tendons, and bones, resulting in poor flow of *qi* and blood, loss of nourishment of muscles, tendons, and bones, which in turn induces symptoms such as postoperative swelling and pain, and difficulty in moving^[13]. Knee joint balancing techniques are based on Chinese medicine massage techniques. Through kneading, pinching, and plucking techniques, adhesions can be released, pain can be relieved, and knee joint movement can be improved. Modern medical research has shown that knee-balancing techniques can accelerate blood flow, reduce the level of pain-causing factors in the knee

joint, and relieve soft tissue adhesions around the knee joint, smooth the joint, relieve muscle tissue stiffness, and increase the range of motion of the knee joint ^[14]. According to another study, total knee arthroplasty can increase the strength of the musculature around the knee, enhance the stability of the knee joint, prevent various adverse events during the active phase of the knee joint, and help improve the recovery of knee joint function after surgery ^[15]. Compared with the conventional rehabilitation training program, the knee joint balancing technique is more comprehensive, it can effectively release adhesions, relieve pain, reduce patients' fear of rehabilitation treatment, improve the soft tissue function of the knee joint, restore the normal anatomical structure, and further improve the artificial knee joint stability, thereby promoting the recovery of knee joint function and gait.

Based on the above analysis, knee-balancing manipulation therapy after total knee arthroplasty can improve knee joint function and restore gait, which has clinical application value. The number of samples of total knee arthroplasty patients selected in this study is small, the specific process of analysis and evaluation still needs to be improved and adjusted, and the research period is relatively short. In-depth analysis on the effects and application of knee-balancing manipulation therapy after total knee arthroplasty is required.

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Disclosure statement

The authors declare no conflicts of interest.

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